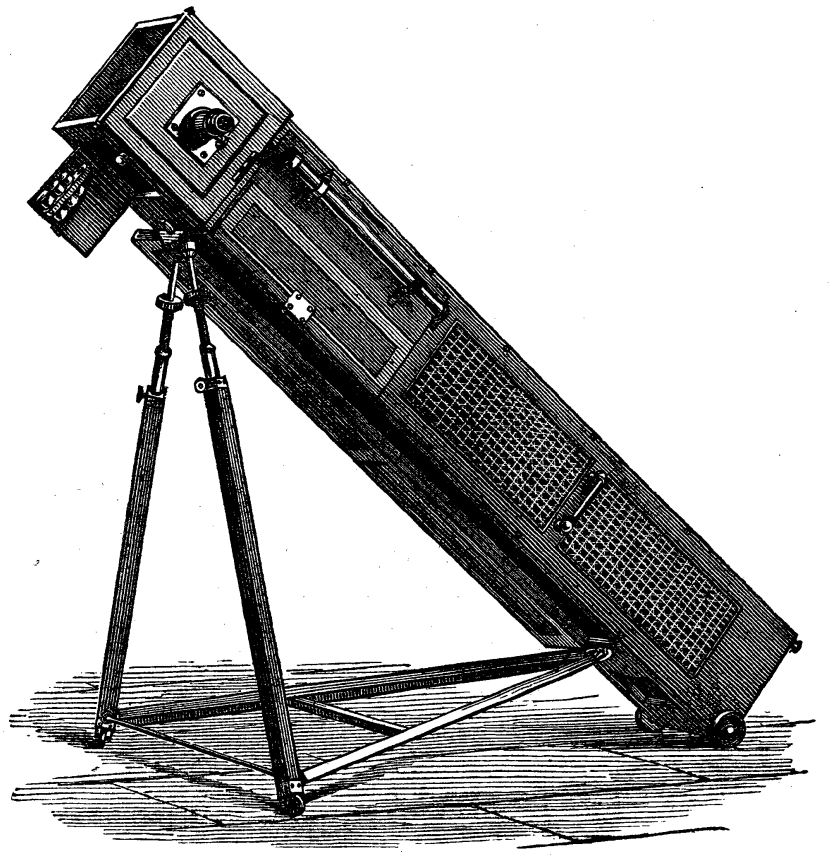
think what has been done is so near perfection that it is difficult to conceive anything superior to be done, when the particular character of the corona is taken into consideration.

June 12, 1872.

On an Altazimuth Mounting for Telescopes, especially adapted for the use of Observers who have no permanent Observatory.

By John Brett.

The engraving intended to illustrate this paper represents a reflecting telescope of the Newtonian form, of $9\frac{1}{4}$-inches aperture and 6 feet 2 inches focus, the mounting of which exhibits certain peculiarities intended to improve the performance of such instruments, as well as certain contrivances calculated to render them



more portable than usual, and more readily available for general use. The principle upon which this mounting depends is applicable to any sort of telescope; but inasmuch as steadiness and smoothness of movement are of comparatively easy attainment in refractors, I propose only to lay before the Society my adaptation of it to reflectors.

The telescope is supported at both ends; the pivot on which

it revolves is placed at the lower end immediately under the speculum; and the power by which it is moved and governed is applied as far as possible therefrom, that is to say, at the eye-piece end of the tube. This disposition is intended to prevent any tendency to oscillation, and to check any vibration that may be set up by the wind or by any accidental cause.

The whole apparatus, telescope and stand, may be briefly described as a tripod with a moveable apex; and the essential peculiarity (and, as I suppose, novelty) of the mounting consists in the means by which the apex is made to move in any required direction.

One leg of the tripod consists of the tube or body of the telescope, the speculum end of which rests on the ground, whilst the eye-piece end, being situated at the apex, is supported by the other two legs.

The telescope having a given length which is invariable, it is obvious that it may be made to stand at any angle to the horizon by the extension or shortening of the other two legs. It is further evident that if these two contractile legs be shortened or lengthened at the same rate, the telescope or third leg will be moved merely in altitude; that if one of them only be extended or reduced the telescope will describe an arc of a circle; whereas, if one leg be lengthened and the other shortened at the same rate, a lateral movement will be communicated to the apex, that is to say, the telescope will move in azimuth only.

It will be seen that the figure of the whole apparatus is that of the simplest of all solids, and since its movements depend entirely on thrust—torsion being wholly excluded, and friction reduced to a very small amount—it is hardly possible to manufacture it so weakly as to produce unsteadiness.

The mounting provides for quick and slow motion both in altitude and in azimuth, besides which it affords a slow motion in a circular direction, which latter may be made equatorial by placing the speculum end or pivot of the telescope on a bench or other support so many degrees higher than the casters of the other two legs as shall equal the latitude of the place of observation. The quick motion in altitude is given by an extension of the two supporting legs, the upper halves of which (consisting of two similar brass tubes about an inch in diameter and about 28 inches long in the particular instrument referred to) are made to draw out of the lower halves, which consist of mahogany cylinders or boxes carrying clamping-screws to fix the brass tubes at the required height. The quick motion in azimuth is given by simply moving the whole tripod on its casters. The slow motion in every direction is communicated by two double-threaded steel screws (18 inches long), which work in the brass tubes and are moved by the observer. The heads of these screws terminate in ball-and-socket joints permanently fixed to the tube of the telescope. Both these screws may be turned at the same time by the observer using both his hands, and the result will be that when both

are moved in one direction the telescope rises in altitude, or in the other direction it descends; but if they are turned in contrary directions the instrument moves in azimuth. The rotation of one screw alone produces a circular motion which, affording as it does a certain approximation to the apparent motions of the stars, allows the observer to keep the object in the field with greater facility than the ordinary altazimuth mounting does, whilst the equality of force required to rotate either of the screws and the smoothness of their action allow the object to be followed without any care or attention, and far more steadily than by the usual Hook's joint.

In this instrument the legs are connected together by slight bars of wood which can be readily folded along with the legs; and when not in use the whole stand, together with the finder, nose-piece, eye-pieces, and all other appendages, retire into the seclusion of the telescope-tube, the door of which shuts them off from the meddling of the curious by closing with a spring-lock. The tube in this instance has been made rectangular, as the cylindrical form was supposed to lend itself favourably to vibrations. The upper side is covered in with panelling to prevent the deposition of dew, but the other sides are filled in with cane-work to prevent air-currents. The door at the upper end is made to open so as to bring the nose-piece exactly opposite to the plane mirror. The door at the lower end allows the cover to be taken off the speculum. The little door underneath carries the eye-pieces, and keeps them close to the observer's hand and away from his pockets. The hollow legs are furnished with spiral springs, which form a counterpoise of increasing power as the weight of the telescope is thrown forward upon them. Here ends the description of the instrument.

It being generally recognised that unsteadiness is alone sufficient to render the best of telescopes utterly useless; that reflectors are peculiarly liable to suffer from this defect; that in order to avoid it great weight and massiveness have almost always been resorted to in their mounting, and that this cumbrousness tends very much to restrict the use of large reflectors to permanent observatories, thereby crippling to some extent the observing power of this Society: supposing that these things are generally admitted, I have thought the characteristics of portability and steadiness to which my principle lends itself with a certain aptness give to this apparatus sufficient claims to attention to warrant my producing it for the inspection of the Fellows; and, if they do not think favourably of the design, they will, I feel sure, appreciate the way in which Mr. Browning has carried it out.

6 *Pump Court, Temple,*
May, 1872.

On certain Phenomena surrounding the Sun's Limb as seen in the Telescope. By John Brett, Esq. (Abstract.)

The appearance to which attention is called may be briefly described as follows:—

When the Sun's disk is examined with a telescope it is seen to be projected, not against an even background of sky-colour of uniform darkness, but upon a patch of weakly luminous halo diluted gradually outwards to an extent of about half a diameter of the Sun beyond his limb, where it dies away and becomes imperceptible. The colour of this halo is of a delicate steel grey with a slight hint of green in it. Its inner region next the limb possesses a certain brightness for about 2′ or rather less, exhibiting some traces of a defined limit at that distance, beyond which the diminution of its light proceeds rapidly. The aperture of the instrument does not seem to affect its visibility much, but the dark glass must not be darker than is necessary for safety. The inner or brighter belt has been seen best with a magnifying power of from 50 to 100 on Mr. Brett's $9\frac{1}{4}$-inch telescope, but, speaking generally of the whole phenomenon, the lower the magnifying power and the larger the field the more perfectly it can be seen. In a small finder, with field of 4° and magnifying power of 5, its appearance is remarkably vivid and strikingly like Mr. Brothers' photograph of the Corona of 1870, and on some occasions appearances exactly like the so-called rifts have been seen.*

By fixing a small strip of paper across the field-lens of a Kellner eye-piece so as to make a bar in the focus across the image, and afford a standard of contrast, the graduation of the light from the limb outwards was made to appear more distinctly, and since that date Mr. Brett has never examined the Sun's limb in good clear sky without detecting a similar appearance.

Mr. Brett has tried all the means he can think of to get rid of it, but in vain. He has shown it to several persons with good eyes (in various telescopes, with all sorts of eye-pieces and different dark glasses, first-reflection prisms, and films of silver), and most of them describe the phenomenon as perfectly obvious.

Mr. Brett invites attention to his paper in the *Notices* of this Society for March, 1871, in which is recorded some account of the Corona as seen during the progress of the eclipse of December, 1870, especially during its earlier stages. On that occasion the Moon's limb outside the Sun was seen by Mr. Brett and Mr. Burton projected dark on a brighter background of sky many minutes before the Sun's disk was covered.

6 *Pump Court, Temple,*
June, 1872.

* In a letter to Dr. Huggins, Mr. Brett mentions that the rifts thus seen are not permanent.

[The phenomena described by Mr. Brett, though not altogether new, afford an interesting subject of inquiry. The comparison of such phenomena as presented when different instruments are employed, when the Sun's image is in different parts of the field, and so on, may possibly throw light on questions relating to the performance of telescopes. It may be, on the contrary, that the phenomena are caused by the presence of matter in the upper regions of the atmosphere; that in fact it is a true atmospheric corona, and related to finely-divided matter very high in the atmosphere, in the same way that the common atmospheric corona is related to the water vesicles of *cumulus* or *cumulo-stratus* clouds. It seems by no means unlikely, indeed, that the phenomenon described by Mr. Brett is the "corona" caused by the particles which form the *cirrus* or *cirro-stratus* cloud. It may be interesting to compare Kaemtz's account of the corona of the cumulus or cumulo-stratus cloud. "If the corona is complete," he says, "several concentric circles are observed. Near the Sun they are of a deep blue, the second circle is white, and the third red, which terminates the first series; in the second we see, still going in the direction from the centre to the circumference, purple, blue, green, pale yellow, and red; the series is rarely thus complete. More frequently we observe near the Sun blue mingled with red, then a white circle clearly limited within, but confounded without with the others. If a second red circle exists outside this, then green is observed in the interval by which they are separated. The distance of this circle from the centre of the Sun varies according to the state of the clouds and atmosphere; I have found it from 1° to 4°." If we remember that such phenomena may be produced by reflected as well as by transmitted light, we see reason for believing that cirrus clouds, according to the usual belief as to their constitution, would produce a real though small corona as well as the haloes which it is their more special part to produce. In thus speaking of cirrus clouds, we have in view as well the dispersed matter which is almost constantly present in the upper air, though not recognisable in distinct cloud forms, as cirrus clouds more properly so termed.

It may be, however, that the phenomena are altogether optical; or, again, they may be merely subjective.

It is hardly necessary to show that the phenomena are not astronomical,—in other words, that the astronomical solar corona has not been seen. Dr. De La Rue has shown how hopeless it must be to attempt to see the prominences (whose light is certainly much brighter than that of the corona, even a few minutes only from the limb):* see vol. xxix. of the *Notices*, p. 81. The Astronomer Royal has tried the following experiment:—A smooth white surface, with a circular aperture, was so placed that

* In 1860, Goldschmidt could perceive a prominence which he had been watching, $3^m\ 40^s$ after the reappearance of the Sun, and believed he could have seen it longer had he not been compelled to withdraw from the observation.

the aperture exactly corresponded to the place where the Sun's image would fall, and the light thus passing through the aperture was quenched in a black bag. When this was done not a trace of the prominences or chromatosphere could be recognised round the aperture. If under these exceptionally favourable circumstances even the prominences could not be seen, it is certain that the corona cannot be seen when the Sun is not eclipsed (unless with some spectroscopic appliances not yet tried). It is sufficient to remark, however, as Lord Lindsay pointed out at the last Meeting, that since the corona cannot be seen through a darkened glass (such as is used in observing the Sun) during total eclipse, though then projected on a dark sky, it cannot possibly be seen through such a glass when the sky is illuminated by the full blaze of sunlight.

While on this subject we may mention a method by which possibly the whole circle of the prominences and sierra might be seen, either with red, yellow, green-blue, or indigo light, when the Sun is not eclipsed. It consists simply in repeating the Astronomer Royal's experiment, but viewing the ring or card through a train of prisms (after the manner proposed by Prof. Young early in 1871 for observing the corona, and applied by Mr. Lockyer during the last eclipse.) Theoretically it appears certain that the complete ring of prominences and sierra should thus be rendered visible at once. Or Sir George Airy's experiment could be repeated with the aid of the spectroscopic arrangement successfully employed by Respighi at Poodoocottah last December. Either method might probably be applied successfully to obtain photographs of the prominences and sierra, the indigo image being employed. It seems barely possible that a faint image of the corona might be detected by this method at the part of the aperture corresponding to Kirchhoff's line 1474. If the method failed under ordinary circumstances, it might be successful at a station very high above the sea-level. The present writer has been confirmed by the high opinion of the Astronomer Royal (to whom this extension of the black-bag method had also occurred), in his belief that valuable results might be obtained from the application of this method.

As regards the visibility of the lunar limb outside the Sun many minutes before or after totality, or in partial eclipses, it is only necessary to mention that theoretically this is to be expected. In an article in *Fraser's Magazine* for December, 1870, the possibility of thus detecting the Moon's limb outside the Sun's during the partial eclipse visible in England during that month was pointed out (before the event) by the present writer, who also can confirm Capt. Noble's statement that the lunar limb can actually be seen on such occasions. It is to be remembered that so soon as a solar eclipse commences the illumination of the atmosphere begins to be reduced, and that at an advanced stage of the partial phase this reduction becomes such that, under favourable atmospheric conditions, the Moon's limb

must necessarily become visible by its relief against the light of the corona (some time before the corona itself can be seen.)—R. A. P.]

Improvements in Tripod Stands. By R. T. Lecky, Esq.

My object in submitting to the Society so very simple a matter as a tripod-stand is, firstly, to place on record the invention of the well-known double, or, as it is commonly called, the French Tripod, so universally used under various forms for photographic cameras, portable telescope-stands, &c.; and, secondly, to show some further changes in its construction which may be usefully employed in various astronomical and geodetic appliances.

The invention of the double-stand is that of a gentleman to whom the scientific world is indebted for having laid the foundation of the vast improvements of later years in the construction of the object-glasses of microscopes, the late Joseph Jackson Lister, Esq., F.R.S., of Upton, Essex, and the stand which I have the pleasure of showing here to-night (kindly lent me by his son, Mr. Arthur Lister) is the first of its sort made in this country about forty years since by the late Mr. Bate, of the Poultry.

Mr. Lister was fond of sketching, and although well able to use his pencil unaided by any optical appliance, used the camera lucida for greater accuracy and speed, and as the ordinary walking-stick-stand was both cumbrous and inconveniently low, he contrived this to carry a small drawing-board, and to fold up and be used as a staff in his walking excursions. The upper portion of each leg is divided, and the short part is hinged to the side of the leg, and the two parts are then connected with a jointed link, which on shutting-up the stand fits into a recess in the side of each part, and the legs are then connected together with ferules, and a movable ring in the usual manner so as to form a light and useful staff. When the legs are opened out, the drawing-board is pinned on to the top and makes a firm table. Mr. Bate was so pleased with the invention that he requested Mr. Lister to allow it to be patented, but this Mr. Lister declined to do, and gave it to the public.

A few years since, on Mr. Lister showing me this stand, it occurred to me that if an ordinary level or theodolite tripod could be adapted to the same use by having a drawing-board braced on to its top; it might be made useful for a greater variety of purposes, and be readily made of materials common to every collection of instruments. I therefore tried a few experiments with the stand I have the pleasure to show you, and the result has been that by placing the board on a loose centre on the top of the tripod, and then applying two cross braces between the

side of the board and the two front legs, and two other braces as an isosceles triangle to the third, or back leg, and then connecting the legs together, the connexion between the front legs being rigid, I made a very firm stand or table, and with the unexpected result, that whereas, to use engineering terms, the first six braces, viz. the four between the sides of the board and the legs, and the two connecting the two front legs to the third or back leg, act as ties, the seventh or rigid connexion between the two front legs becomes a strut, and, as such, its action is to tighten all the other ties or braces, thus giving the table the requisite degree of stability.

The braces I have in this case made of spring steel for lightness, but they may be of chain or wire, and if with the strut were made adjustable, by screws or otherwise, the table could be adjusted as to level, or to any required degree of obliquity.

As to the different uses to which a stand of this kind is applicable, I may mention the old-fashioned but useful surveying instrument, the Plane Table, which, with this mode of bracing, may be made of much larger size than is usual, and be constructed with greater accuracy. It would also form a firm and convenient stand for various uses in the observatory as well as in the field; light, portable, and easily taken asunder and stowed in a small space, at the same time not interfering with the other uses of the tripod. Doubtless other uses will suggest themselves in practice.

Memoir on the Theories of the four Superior Planets, Jupiter, Saturn, Uranus, and Neptune. By M. Le Verrier.

An abstract of a memoir by M. Le Verrier on the theories of the four exterior planets is inserted in No. xxi., for May 20, 1872, of the *Comptes Rendus*. The subject is of great importance, and one deeply interesting to many Fellows of this Society. The following is a translation of the principal portion of the abstract.

"On several occasions I have had the honour of laying before the Academy a series of investigations relating to the system of the four planets nearest to the Sun; viz., *Mercury*, *Venus*, the *Earth*, and *Mars*. Although at an earlier period, I had already been occupied in the study of the larger planets, I have felt the necessity, before continuing the investigation, of establishing on a solid foundation the theory of the *Earth's* motion, which serves as the basis of all the others. This study led me to the consideration of the three planets situated nearest the *Earth*, and which constitute the inferior portion of the planetary system.

"These researches have shown that the motions of the *Earth* and *Venus* are represented by the theory with all the accuracy which the observations will admit of. *Mercury* and *Mars*, however, showed some irregularities.